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EXAMINER	
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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/511,784
Filing Date: October 15, 2004
Appellant(s): PRIEDEMAN ET AL.

Brian Morrison
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed August 3, 2010 appealing from the Office action mailed February 3, 2010.

(1) Real Party in Interest

The examiner has no comment on the statement, or lack of statement, identifying by name the real party in interest in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The following is a list of claims that are rejected and pending in the application:

Claims 1, 3-5, 8, 10, 11, 18, 20-23, 27, 28, 33, 43, and 45-49 are rejected.

(4) Status of Amendments After Final

The examiner has no comment on the appellant's statement of the status of amendments after final rejection contained in the brief.

(5) Summary of Claimed Subject Matter

The examiner has no comment on the summary of claimed subject matter contained in the brief.

(6) Grounds of Rejection to be Reviewed on Appeal

The examiner has no comment on the appellant's statement of the grounds of rejection to be reviewed on appeal. Every ground of rejection set forth in the Office action from which the appeal is taken (as modified by any advisory actions) is being maintained by the examiner except for the grounds of rejection (if any) listed under the subheading "WITHDRAWN REJECTIONS." New grounds of rejection (if any) are provided under the subheading "NEW GROUNDS OF REJECTION."

(7) Claims Appendix

The examiner has no comment on the copy of the appealed claims contained in the Appendix to the appellant's brief.

(8) Evidence Relied Upon

Appellants Specification Pages 1-4 and 8 and the declaration of Zinniel submitted 11/18/09 considered "Admitted Prior Art"

U.S. Patent 5,121,329	Crump	6-1992
U.S. Patent 3,807,054	Joseph et al.	4-1974
U.S. Patent 5,448,838	Edmonds	9-1995
U.S. Patent 5,653,925	Batchelder	8-1997
U.S. Patent 6,022,207	Dahlin et al.	2-2000
U.S. Patent 5,143,663	Leyden et al.	9-1992
U.S. Patent 4,983,223	Gessner	1-1991

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1, 3, 8, 10, 11, 18, 21, 22, 27, 28, 33, 43, 45, and 47-49 are rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art (Specification pages 1-4 and 8 and optionally the Zinniel declaration submitted 11/18/09) as exemplified in part by Crump (U.S. Patent 5,121,329) in view of Joseph et al. (U.S. Patent 3,807,054) or Edmonds (U.S. Patent 5,448,838) and optionally Batchelder (U.S. Patent 5,652,925).

The admitted prior art discloses it was known to make a three-dimensional object by building an object from a thermoplastic modeling material using fused deposition molding wherein the built object has an object surface formed of the modeling material including an object surface formed of a plurality of layers as exemplified by Crump (Page 1, line 6 - Page 2, line 15 of the specification and Column 3, lines 64-66 of Crump). The admitted prior art further teaches that due to the layered manufacturing process the object surface formed of the modeling material exhibits at least one surface effect the effect considered to extend substantially across an entirety of the object because the layers extend substantially across an entirety of the object. The at least one surface effect is a stair step effect, striation, or a surface roughness present due to errors in building the object which at least one surface effect detracts aesthetically from the object wherein manual/by hand techniques were known for smoothing the object surface (Page 2, line 16 - Page 3, line 17 of the specification). Furthermore, due to the fused deposition modeling technique the object necessarily exhibits porosity as evidenced by the admitted prior art (See specifically the Zinniel declaration submitted 11/18/09) or Batchelder (Column 1, lines 31-41

and Column 2, lines 6-31). It is well known in the art that thermoplastic object surfaces formed as having a surface effect such as voids, cracks, scratches, and other surface roughness may be smoothed by exposing the object to vapors of a solvent such as methylene chloride that transiently softens the thermoplastic material at the object surface and reflows the softened thermoplastic material to uniformly smooth the object surface as shown by Joseph or Edmonds (Figure 6 and Column 1, lines 5-11 and Column 2, lines 3-11 and Column 4, lines 1-17 of Joseph and Figure 1 and Column 1, lines 6-14 and Column 2, lines 6-10 and 52-56 and Column 3, lines 1-8 of Edmonds), it being further noted the admitted prior art recognizes smoothing plastics with vapors of a solvent was known (Page 3, line 18 - Page 4, line 20 of the specification). It would have been obvious to one of ordinary skill in the art at the time the invention was made to smooth the object surface, i.e. substantially eliminate the surface effect, as taught by the admitted prior art as exemplified in part by Crump which surface necessarily exhibits porosity as optionally evidenced by the admitted prior art or Batchelder by using vapors of a solvent as was well known and shown by Joseph or Edmonds to easily and uniformly smooth the object surface across the entirety of the object without having to manually do so by hand wherein the smoothing substantially eliminates the porosity of the object at the object surface as Joseph expressly describes voids are filled by the smoothing and the materials and method taught by the admitted prior art as exemplified in part by Crump and modified by Joseph or Edmonds and optionally Batchelder is the same as that discussed in the Zinniel declaration submitted 11/18/09 demonstrating the method necessarily substantially eliminates the porosity.

In the event the porosity is not necessarily eliminated the following rejection would apply. It would have been obvious to one of ordinary skill in the art at the time the invention

was made to perform the step of smoothing the object surface in the admitted prior art as modified above until the surface is completely smooth/non-porous only the expected result of forming a uniformly smooth surface being achieved.

Regarding claim 8, the length of time the object is exposed to the solvent vapors as taught by the admitted prior art as modified must be selected as a function of the concentration of the solvent vapors prior to exposing the object otherwise the uniformly smooth object surface would not be formed. In the event it is shown the length of time is not necessarily selected as a function of the concentration of the solvent vapors the following rejection would apply. It would have been obvious to one of ordinary skill in the art at the time the invention was made to select the length of time the object is exposed to the solvent vapors as taught by the admitted prior art as modified above as a function of the concentration of the solvent vapors prior to exposing the object such that when the object is removed from the solvent vapors the surface is uniformly smooth.

Regarding claims 10, 27, 28, and 49, the admitted prior art discloses known solvent masking substances include gum, waxes, pastes, adhesives or masking tape (Page 8, lines 24-26). It would have been obvious to one of ordinary skill in the art a the time the invention was made to include in the admitted prior art as modified above known solvent masking substances such as those shown by the admitted prior art as a function of inhibiting smoothing in areas where aesthetically surface roughness or other non-smoothing effect is desired wherein the specific technique for applying the substances which are similar to the thermoplastic molding material would have included the same fused deposition molding equipment as used to apply the thermoplastic molding material such that further equipment is not required.

Regarding claim 18 and 48, the object taught by the admitted prior art as modified above is exposed the vapors of the solvent by suspending the object on a wire mesh within a chamber containing the vapors of the solvent in a manner that substantially allows the entirety of the object surface to be exposed to the vapors of the solvent as shown by Joseph (Column 2, lines 25-39). It is noted "suspending" is given its usual definition of to keep from falling as if by hanging. In the event it is shown the term "suspending" by itself requires the object to be hanging by an attachment above as opposed to as if by hanging the following rejection would apply. It would have been obvious to one of ordinary skill in the art at the time the invention was made place the object taught by the admitted prior art as modified above in the chamber containing the vapors of the solvent using any means of placing an object in a chamber such as by hanging from an attachment above the object or by sitting on an attachment below the object as both would achieve the same result.

Claims 4, 5, 23, and 46 are rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art as exemplified in part by Crump and Joseph or Edmonds and optionally Batchelder as applied to claims 1, 3, 8, 10, 11, 18, 21, 22, 27, 28, 33, 43, 45, and 47-49 above, and further in view of Dahlin et al. (U.S. Patent 6,022,207).

The admitted prior art as modified above teaches all of the limitations in claims 4, 5, 23, and 46 except for a teaching of the specific thermoplastic material used, it being noted the admitted prior art makes reference to Dahlin as a known rapid prototyping technique. Dahlin directed to rapid prototyping similar to the admitted prior art discloses a particularly suitable thermoplastic is ABS (Column 4, lines 3-4). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use as the thermoplastic material in the admitted

prior art as exemplified by Crump and modified by Joseph or Edmonds and optionally Batchelder ABS a known suitable material such as shown by Dahlin.

Claims 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art as exemplified in part by Crump and Joseph or Edmonds and optionally Batchelder as applied to claims 1, 3, 8, 10, 11, 18, 21, 22, 27, 28, 33, 43, 45, and 47-49 above, and further in view of Leyden et al. (U.S. Patent 5,143,663).

The admitted prior art as modified above teaches all of the limitations in claim 20 except for a teaching of modifying an initial object representation to pre-distort certain features of the surface geometry, it being noted the admitted prior art discloses the fused deposition molding equipment includes a computer aided machine (CAM) operating in conjunction with a computer aided design procedure (CAD) as exemplified in Crump (Column 1, lines 15-24) which computers are considered to create a digital representation of the final three-dimensional object and control the fused deposition molding equipment to form the final three-dimensional object from a provided initial object representation in a digital format wherein the initial object representation has a surface geometry, the object built in the building step has a geometry defined according to the object representation, and the geometry attained following the exposing step approximately matches that of the initial object representation. The admitted prior art makes reference to Leyden as a known rapid prototyping technique. Leyden directed to rapid prototyping similar to the admitted prior art discloses the object is built oversize so that after the surface roughness is removed the object will be the right size (Column 7, lines 25-36). It would have been obvious to one of ordinary skill in the art at the time the invention was made to include in the admitted prior art as exemplified by Crump and modified by Joseph or Edmonds

and optionally Batchelder a step of modifying the initial object representation to pre-distort certain features of the surface geometry so that after the surface roughness is removed the object will be the right size as shown by Leyden.

Claims 18 and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art as exemplified in part by Crump and Joseph or Edmonds and optionally Batchelder as applied to claims 1, 3, 8, 10, 11, 18, 21, 22, 27, 28, 33, 43, 45, and 47-49 above, and further in view of Gessner (U.S. Patent 4,983,223).

As noted above, the object taught by the admitted prior art as modified above is exposed to the vapors of the solvent by suspending the object on a wire mesh within a chamber containing the vapors of the solvent in a manner that substantially allows the entirety of the object surface to be exposed to the vapors of the solvent as shown by Joseph. It is noted "suspending" is given its usual definition of to keep from falling as if by hanging. In the event it is shown the term "suspending" by itself requires the object to be hanging by an attachment above as opposed to as if by hanging the following rejection would apply. It was known in the art to expose an object to vapors of a solvent by suspending the object in the vapors by hanging as shown by Gessner wherein suspending the object as shown by Gessner allows the process to be conducted in a such a manner that the solvent vapors are discharged into the atmosphere at a level much less than is conventional (Column 5, lines 59-63 and Column 6, lines 47-59). It would have been obvious to one of ordinary skill in the art at the time the invention was made to expose the object to the vapors of the solvent as taught by the admitted prior art as exemplified by Crump and modified by Joseph or Edmonds and optionally Batchelder using a conveyor wherein the object is hanging as shown by Gessner whereby the object surfaces are exposed to

the vapors of the solvent with the solvent vapors discharged into the atmosphere being much less than is conventional.

(10) Response to Argument

Response to arguments regarding the rejection of claims 1, 3, 8, 10, 11, 18, 21, 22, 27, 28, 33, 43, 45, and 47-49:

> Appellants argue on page 8, "Neither Joseph nor Edmonds disclose or suggest the use of three-dimensional objects built using the fused deposition modeling technique, or the substantial elimination of surface effects due to the fused deposition modeling technique. Joseph are Edmond each directed to the use of vaporized solvents on articles (e.g., telephone casings) to remove scratches, dents, blemishes, small voids, and the like (e.g., for refurbishing such articles) (see e.g., Joseph, col. 4, lines 42-48; and Edmonds, col. 2, lines 43-51 and col. 3, lines 1-8).".

Joseph and Edmonds each suggest the elimination of surface effects of three-dimensional thermoplastic objects using vaporized solvents for both new and restored objects. It is acknowledged that neither Joseph nor Edmonds expressly describe the objects as formed using a "fused deposition modeling technique". However, neither reference is concerned with how the three-dimensional thermoplastic objects are formed, e.g. neither reference describes how any of the objects are formed. The solvent smoothing technique disclosed by each reference is simply directed to use with three-dimensional thermoplastic objects having a surface effect requiring removal and smoothing wherein the technique is not described in any way as effective or dependent on how the object is formed.

> Appellants further argue on pages 8 and 9, "As illustrated in FIG. 1 of the present application (reproduced above), the surface effects due to the fused deposition modeling technique extend substantially across the entire surface of the three-dimensional object, including the bottom surface 16 (present application, FIG. 1; page 2, lines 16-30; page 5, line 24 to page 6, line 2; and page 6, lines 17-20). This differs from surfaces merely

> having defects such as scratches, dents, blemishes, and small voids, or that merely require polishing, as recited in Joseph and Edmonds.".

Neither Joseph nor Edmonds limit the size of the surface effect to be eliminated or smoothed or suggest that surface effects extending substantially across the entire surface of the object are somehow not eliminated and smoothed. For example, Joseph teaches at column 2, lines 3-8 "Each article is subjected to the solvent vapor sufficiently to cause the substance of the vapor to penetrate the plastic surface and soften it *so that the plastic material will flow at the surface, thereby filling the cracks, scratches and voids thereof to produce a smooth uniform surface*." (Emphasis added) and there is no suggestion that the cracks, scratches and voids eliminated and smoothed are limited to any particular size. The same may be said for Edmonds which teaches at column 2, lines 53-57 "Preferably the surface will be exposed to a particular concentration of solvent vapor for a period of time *such that the surface will flow to eliminate any defects on the surface* and yet not flow excessively or become opaque due to over exposure of the solvent vapor." (Emphasis added).

> Appellants further argue on page 9, "Additionally, the Examiner has not provided any articulated reasoning as to why one skilled in the art would be motivated to modify the teachings in Joseph or Edmond to substantially eliminate surface effects due to the fused deposition modeling technique, and which extend substantially across the entire surface of the three-dimensional object." and "Instead, the Examiner merely provides a conclusory statement that there is no teaching or suggestion that the process would not perform the same. This is not sufficient to establish a prima facie case for obviousness, particularly in view of Applicants' showing that those skilled in the art rely on techniques such as manual trimming, machining or grinding, buffing with cloths, sand paper, or solution-born abrasives, and the like.".

It noted that it is the admitted prior art as exemplified in part by Crump that is modified with the teachings of Joseph or Edmonds and not the teachings in Joseph or Edmond that are modified. The conclusory statement referred to by appellants was made in the advisory action in

response to appellants arguments that neither Joseph nor Edmonds disclose or suggest the use of three-dimensional objects built using the fused deposition modeling technique. Articulated reasoning as to why one of ordinary skill in the art would modify the admitted prior art as exemplified in part by Crump with the teaching in Joseph or Edmonds was fully set forth in the rejection, i.e. to easily and uniformly smooth the object surface across the entirety of the object without having to manually do so by hand.

> Appellants further argue on page 9, "In fact, solvent vapors are not suitable for smoothing objects built from all forms of layered manufacturing rapid prototyping techniques. For example, objects built with layered manufacturing rapid prototyping techniques such as the stereolithographic processes of Leyden use solvent vapors to remove excess resins (Leyden, col. 6, lines 56-68; col. 9, lines 34-39; and col. 11, lines 35-44). These processes require subsequent smoothing processes, such as applying and curing an additional amount of the curable resin to fill in the surface discontinuities, to provide smooth surfaces (Leyden, col. 7, lines 1-15).".

It is initially noted the Leyden reference is not relied upon to teach using solvent vapors for smoothing. In any event, Leyden teaches a stereo lithographic process for manufacturing an object in a vat of resin wherein following removal of the object from the vat and prior to setting the surface of the object excess liquid resin is removed from the part by placing the part on an absorbent pad. Leyden optionally discloses combining the use of the absorbent pad with a solvent to assist in removing the excess liquid resin. The object then formed in Leyden after setting the surface of the object includes surface effects such as a stair step effect similar to the admitted prior art which effects are removed by either adding additional resin to fill in the effects or sanding as again similar to the admitted prior art to remove the effects (See the column and lines referred to by appellants particularly columns 6 and 7). It is unclear how the use of an absorbent pad and solvent to drain excess liquid resin from an object formed in a stereo lithographic process prior to setting the surface of the object evidences solvent vapors are not

suitable for smoothing objects built from all forms of layered manufacturing rapid prototyping techniques. The direction provided by both Joseph and Edmonds is that solvent vapors are suitable for smoothing objects built from plastic without limitation as to any particular technique used to form the object.

> Appellants further argue on page 10, "With respect to the first allegation, the voids taught by Joseph are not porosity due to the fused deposition modeling technique. This is an erroneous conclusion made by the Examiner. The porosity due to the fused deposition modeling technique are pores entrained within the walls of the object. The mere fact that Joseph mentions that the solvent vapor process may be used to fill small voids does not teach or suggest to one skilled in the art that the claimed process in the present application may substantially eliminate porosity of the object at the object surface.".

It is not asserted that the voids taught by Joseph are porosity due to the fused deposition modeling technique. Joseph teaches filling "cracks, scratches and voids" and Edmonds teaches eliminating "any defects on the surface". Thus, it is the position of the examiner that one of ordinary skill in the art would readily expect a technique that fills cracks, scratches and voids and any defects on an object surface to also fill and eliminate pores of the object at the object surface, i.e. the result is expected. Additionally, because evidence of unexpected results must be weighed against evidence supporting *prima facie* obviousness in making a final determination of the obviousness of the claimed invention the evidence supporting obviousness, i.e. to easily and uniformly smooth the object surface across the entirety of the object without having to manually do so by hand, is considered to outweigh the unexpected result of filling pores in the object surface to the extent that this result may be considered unexpected.

> Appellants further argue on page 11, "In the Advisory Action, the Examiner stated that it is not clear why the admitted prior art as modified does not necessarily result in the reduced porosity. Applicants believe that the confusion with this issue centers around the meaning of the phrase "as modified". The Examiner did not elaborate which reference is being relied upon for the modification. Applicants assert that the Zinniel

> Declaration demonstrates that the admitted prior art as modified by the teachings of the present application necessarily results in substantially eliminating porosity of the object at the object surface. Thus, the Zinniel Declaration demonstrates that the substantial elimination of porosity of the object at the object surface is an unexpected result sufficient to overcome the prior art.".

Appellants specification and claims as originally filed did not disclose that the object exhibits porosity due to the fused deposition modeling technique or that reflowing the softened modeling material substantially eliminates the porosity of the object at the object surface. Appellants asserted in the response filed 11/18/09 that these were inherent features to the claimed invention pursuant to MPEP 2163.07 and submitted the Zinniel Declaration in support of the assertion. The admitted prior art as modified, i.e. the admitted prior art as exemplified by Crump and modified by Joseph or Edmonds and optionally Batchelder as set forth in the rejection, teaches each step of the claimed invention, and thus, must necessarily also result in the limitations relating to the porosity and elimination thereof as otherwise these features cannot be said to be an inherent feature to the claimed invention pursuant to MPEP 2163.07.

> Appellants further argue on page 12, "While these surface effects typically do not affect the strengths of the three-dimensional objects, they do detract aesthetically (present application, page 2, lines 16-22). As such, there has been a long-felt need to eliminate the surface effects of three-dimensional objects built by layered manufacturing rapid prototyping techniques, including objects built by the fused deposition modeling technique. In fact, as discussed in the present application, attempts have been made to smooth the surfaces of such objects by manually trimming, machining, grinding, or buffing with cloths, sand paper, or solution-born abrasives (present application, page 3, line 6-17). However, such removal techniques also remove portions of the object surface, which can damage the fine features of the object, and are labor intensive.".

Establishing long-felt need requires objective evidence that an art recognized problem existed in the art for a long period of time without solution. The relevance of long-felt need and the failure of others to the issue of obviousness depends on several factors. First, the need must have been a persistent one that was recognized by those of ordinary skill in the art, and second

the long-felt need must not have been satisfied by another before the invention by appellants. The admitted prior art and Leyden do disclose the need to remove the surface effects such as a stair step effect necessarily present on three-dimensional objects built by layered manufacturing rapid prototyping such that each identifies a problem. Further, each teaches eliminating the problem for example by manually trimming, sanding, etc. as in admitted prior art or filling in the effect with resin or removing the effect with sanding as in Leyden. Thus, the long-felt need was satisfied by another before the invention by appellants.

> Appellants further argue on pages 13 and 14, "In the Advisory Action, the Examiner stated that Applicants have not provided objective evidence that an art recognized problem existed in the art for a long period of time without solution regarding the elimination of porosity inherent to the fused deposition modeling technique. Applicants respectfully disagree with this contention and note that the porosity in three-dimensional objects built with the fused deposition modeling technique is discussed in Batchelder, U.S. Patent No. 5,653,925, filed in September, 1995 (Zinniel Decl., ¶ 10). This is objective evidence that the need for water-tight objects existed since at least this date. Furthermore, the tests presented in the Zinniel Declaration provide objective evidence that such parts are indeed porous, thereby allowing fluids to pass through the walls of the three-dimensional objects. This is sufficient objective evidence to establish the long-felt need for substantially eliminating the surface porosity to provide as real, usable parts.".

Establishing long-felt need requires objective evidence that an art recognized problem existed in the art for a long period of time without solution. The relevance of long-felt need and the failure of others to the issue of obviousness depends on several factors. First, the need must have been a persistent one that was recognized by those of ordinary skill in the art. While Batchelder does recognize that objects built with the fused deposition modeling technique exhibit porosity, there is no disclosure in Batchelder that this a problem in that the porosity must be eliminated. Further, Batchelder does not teach there was a need to form water-tight objects using the fused deposition modeling technique but this was not possible because no solution existed for

eliminating the porosity at the surface of the objects. The tests presented in the Zinniel declaration do not provide any objective evidence that an art recognized problem existed in the art for a long period of time without solution, e.g. the tests do not demonstrate the problem was a persistent one recognized by those of ordinary skill in the art.

> Appellants further argue on page 14, "Moreover, the plastic articles that are smoothed pursuant to Joseph and Edmonds are typically built from an injection molding or similar technique, and do not exhibit such porosity issues. Thus, the plastic articles do not exhibit any reduction in surface porosity.".

Neither Joseph nor Edmonds teach the objects are typically built from an injection molding or similar technique. Further, neither references suggests using solvent smoothing to eliminate any defects on the surface of the plastic objects is in any way dependent upon the technique used to form the plastic object.

Response to arguments regarding the rejection of claims 4, 5, 23, and 46:

No further arguments are made.

Response to arguments regarding the rejection of claim 20:

No further arguments are made.

Response to arguments regarding the rejection of claims 18 and 48:

No further arguments are made.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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